



EVALUATION OF VEGETABLE PRODUCTIVITY UNDER RAINFED CONDITIONS OF TRIBAL HABITATIONS

V. VIJAYA GEETHA¹ AND M. BHASKARAN²

¹ Assistant Professor, Department of Seed Science and Technology, Krishi Vigyan Kendra, TNAU,
Vriddhachalam, INDIA

² Special Officer (Seeds), Seed Centre, TNAU, Coimbatore - 641 003, INDIA

Abstract: The main goal of the study is rehabilitation and improving the productivity of land owned by tribals and other forest dependents of Hosur forest division into a productive agro system by improving the economic profitability of the people. In these areas, crop production is ventured, which is subjected to high degree of uncertainty in terms of productivity. It is imperative to evolve a suitable strategy for augmenting the productivity of such soils. Vegetable crops provide an important source of income for all the small and marginal farmers of our country. Besides, these crops form an important source of minerals, vitamins and fibre in the largely vegetarian diet of our people. At present the vegetable crops occupy an area of 6.47 million hectares constituting little over 3.5 per cent of total cropped area of the country with a total production of 80 million tonnes (Anon, 2002). Although India is the second largest producer of vegetables and other crops, the productivity is very low and there is a greater need to enhance per hectare productivity gradually to boost the production. Studies were carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore and Kottayam village of Denganikottai range of Hosur Forest Division, Krishnagiri to elucidate information on seed quality enhancement techniques for successful establishment and improving the productivity of bhendi cv. Arka Anamica, tomato cv. PKM 1, chilli cv. K2 and cluster bean cv. Pusa Navbhar under rainfed condition of tribal habitations. In all the vegetables studied, seeds hardened with KH_2PO_4 @ 0.5 % recorded positive results in respect of field emergence, plant height, early flowering, and maximum fruit weight and fruit yield under field condition. Same results were obtained from laboratory and pot culture studies.

Key words: Vegetable seeds, Hardening, Bhendi, Clusterbean, Chilli Tomato

I. INTRODUCTION

In India out of the total population, 8 per cent accounting nearly 168 million people are tribal farmers. Out of these a reasonable population lives in the hilly areas of northwestern regions of Tamil Nadu comprising Krishnagiri as one of the district (Anon 2002). The tribal farmers in those areas practice traditional crop cultivation methods and realize very little output. Hence, the life style of those farmers contributed by their crop components in their farming and per capita income has not met with any improvement over the past several decades. Although several agro techniques possibly capable of improving their net income as well as their standard of living are available, the ignorance of the farmers due to their remoteness has been a major negative factor. The present study under the Forest Development Agency sponsored research programme mainly focussed to obviate the maladies existing in the tribal society in the way of knowledge gain and adoption of newer techniques. The existing crop components comprise of only ragi and mochai of traditional varieties. The traditional varieties are not only poor in their yield but are also marginally managed. Enormous studies have indicated suitability of many diverse coarse cereals, pulses and vegetable crops for conditions, similar to the study area. The scientific evaluation and demonstration of diverse crop components in terms of crop species as well as genotypes will go a long way to enlighten this knowledge poor farming society to widen their activities in order to have a significant gain in health and income.

Vegetable crops provide an important source of income for all the small and marginal farmers of our country. Besides, these crops form an important source of minerals, vitamins and fibre in the largely vegetarian diet of our people. At present the vegetable crops occupy an area of 6.47 million hectares constituting little over 3.5 per cent of total cropped area of the country with a total production of 80 million tonnes (Anon, 2002). Although India is the second largest producer of vegetables and other crops, the productivity is very low and there is a greater need to enhance per hectare productivity gradually to boost the production. Taking into consideration of the present status of farming in the study area where the farmers cultivate monotonous monocrops over the past several years without adoption of any improved agro techniques under rainfed conditions, this study was programmed with the following objective of evaluation of the sustainability of improved varieties of vegetables under rainfed condition.

II. MATERIALS AND METHODS

Materials

Genetically pure seed materials of different kind and varieties were obtained as furnished below and served as the base materials for the laboratory, pot culture and field experiments.

To realize the various objectives of the study, the seeds were treated and evaluated both in laboratory and pot culture at department of Seed Science and Technology Tamil Nadu Agricultural University, Coimbatore during 2002-04. The field experiments were conducted at Kottayam village, Denganikottai range of Hosur Forest Division, Krishnagiri, Tamil Nadu, (Plate1&2). Throughout the crop growth period of field experiment, the crops showered through normal receipt of rainfall combined with optimal climatic condition.

Crop	Cultivar	Source
Tomato (<i>Lycopersicon esculentum</i>)	PKM 1	Department of Seed Science and Technology, TNAU, Coimbatore.
Bhendi (<i>Abelmoschus esculentus</i>)	Arka Anamica	Department of Seed Science and Technology, TNAU, Coimbatore.
Cluster bean (<i>Cyamopsis tetragonoloba</i>)	Pusa Navbhagar	Department of Seed Science and Technology, TNAU, Coimbatore.
Chilli (<i>Capsicum annum</i>)	K2	Rasi Seeds, (P) Ltd, Attur.

Methods

Influence of seed hardening in vegetables

The vegetable crop seeds viz., Tomato cv. PKM-1, Bhendi cv. Arka Anamica, Cluster bean cv. Pusa Navbhar and Chilli cv. K 2 were cleaned and hardened as detailed below and air dried in shade to its original moisture content of 8%.

Treatment

- T₁ - Control
T₂ - Seed hardening with KCl @ 1% for 16 h.
T₃ - Seed hardening with KH₂PO₄ @ 0.5% for 16 h.

Laboratory evaluation

The hardened seeds of all vegetables were evaluated along with control in laboratory during 2003 by adopting Completely Randomized Design with seven replications and recorded the following seed quality parameters.

Germination (ISTA, 1999)

Vigour index Abdul-Baki and Andesson (1973)

Pot culture experiment

A pot culture study was conducted during 2003 with treatments T₁ to T₃ as above in the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore by adopting Completely Randomized Design with seven replications and the following observations were recorded in the each treatment.

No. of fruits plant⁻¹

The number of fruits plant⁻¹ at maturity was counted and the mean fruit plant⁻¹ was calculated and expressed as whole number.

Fruit yield plant⁻¹

The fruit yield plant⁻¹ was calculated using fruit weight and the mean fruit yield was recorded in g.

Field experiment

A field trial was conducted during 2003–2004 at Kottayam village, Denganikottai range of Hosur Forest Division under rainfed conditions by adopting Randomized Block Design with seven replications. The crop was raised with recommended package of practices under rainfed condition and the following parameters were recorded.

Number of fruits plant⁻¹

Fruit yield plant⁻¹

III. STATISTICAL ANALYSIS

The data collected from the various experiments were analysed statistically by adopting the technique described by Panse and Sukhatme (1985). Wherever necessary, the values expressed in percentage were transformed in to Arc sine values before analysis. The critical difference (CD) was calculated at 5% probability level. Wherever “F” value is non- significant is denoted as NS.

IV. RESULTS

Germination (per cent) (Table 1)

Germination percentage of bhendi varied significantly due to hardening treatments. The seeds from T₃ recorded the highest germination of 94 per cent and the lowest germination was recorded in T₁ (82 %). The result of hardening treatments revealed significant difference in germination percentage of tomato. The maximum germination percentage of 92 was recorded in T₃, while the lowest percentage recorded in T₁ (82). Significant differences were observed among the treatments in respect of germination percentage in chilli. Among the treatments, the seeds given with T₃ treatment recorded maximum germination percentage of 93 and the lowest germination was recorded in T₁ (86 %). The results of hardening treatment showed significant

differences in germination per cent of cluster bean. The maximum germination percentage of 95 was recorded in T₃, while the lowest value was recorded in T₁ (86 %).

Vigour index (Table 1)

Vigour index values of all the treatments in bhendi were significantly higher when compared to T₁. The seeds given with T₃ treatment recorded the highest vigour index (1607) followed by T₂ (1366) and the lowest vigour index was recorded by T₁ (1041). The response of hardening treatments to vigour index in tomato was highly significant. Vigour index was highest in T₃ (1132) and lowest in T₁ (746). The computed vigour index values of chilli showed significant difference among the treatments. Higher values were recorded in T₃ (922), while lowest vigour index recorded in T₁ (686). Response of hardening treatments to vigour index of cluster bean was highly significant. Among the treatments, T₃ recorded highest vigour index (1594) compared to T₁ (1236).

Pot culture experiment

Number of fruits plant⁻¹ (Table 2)

The influence on number of fruits plant⁻¹ in bhendi due to the treatments were significant. Maximum number of fruits were found in T₃ (15), while minimum was recorded by T₁ (13). The number of tomato fruits plant⁻¹ varied significantly due to treatments. The plants from seeds treated with T₃ recorded the maximum fruit numbers (18), while T₆ recorded the minimum fruit (14). There was a significant difference due to treatments in respect of number of chilli fruits plant⁻¹. Among the treatments T₃ recorded maximum number of fruit (25) compared to T₁ (20). There was a significant difference in number of cluster bean fruits plant⁻¹ due to treatments. Among the treatment, T₃ recorded the maximum number of 26 fruits, while T₁ recorded the minimum of 23 fruits plant⁻¹.

Table 1. Effect of seed hardening treatment on germination (per cent) and vigour index of bhendi cv. Arka Anamica, Tomato cv. PKM 1, Chilli cv. K2 and Cluster bean cv. Pusa Navbhar

Treatment (T)	Bhendi cv. Arka anamica		Tomato cv. PKM 1		Chilli cv. K2		Cluster bean cv. Pusa Navbhar	
	Germination	Vigour index	Germination	Vigour index	Germination	Vigour index	Germination	Vigour index
T ₁	82 (64.92)	1041	82 (64.92)	746	86 (67.77)	686	86 (68.33)	1236
T ₁	82 (64.92)	1041	82 (64.92)	746	86 (67.77)	686	86 (68.33)	1236
T ₂	87 (68.91)	1366	86 (68.06)	937	90 (71.27)	830	89 (70.91)	1396
T ₃	94 (75.95)	1607	92 (73.65)	1132	93 (74.32)	922	95 (77.26)	1594
Mean	88 (69.93)	1388	87 (68.88)	938	90 (71.12)	815	90 (72.17)	1409
CD (P=0.05)	4.00	6.21	3.99	4.0	2.31	7.2	3.40	8.32

(Figures in parentheses indicates arc sine values)

Fruit yield (g plant⁻¹) (Table 2)

The yield of fruit plant⁻¹ was significantly influenced by different treatments in bhendi. The fruit yield was higher in T₃ (270g), while lower in T₁ (182g). The plant yield varied significantly due to treatments in tomato. The seeds from T₃ treatment recorded the maximum yield (540g) compared to T₁ (364g). The chilli fruit yield plant⁻¹ varied significantly among the treatments. Maximum fruit yield was recorded in T₃ (225g), while T₁ recorded the minimum yield (140g). Fruit yield plant⁻¹ varies significantly due to hardening treatments in cluster bean. Fruit yield from the plants of T₃ recorded the maximum of 156g compared to T₁ (115g).

Table 2. Effect of seed hardening treatments on No. of fruits/plant and fruit yield (g plant⁻¹) of bhendi cv. Arka Anamica and Tomato cv. PKM 1, Chilli cv. K2 and Cluster bean cv. Pusa Navbhar under pot culture experiment

Treatment (T)	Bhendi cv. Arka anamica		Tomato cv. PKM 1		Chilli cv. K2		Cluster bean cv. Pusa Navbhar	
	No. of fruits plant ⁻¹	Fruit yield/plant	No. of fruits plant ⁻¹	Fruit yield/plant	No. of fruits plant ⁻¹	Fruit yield/plant	No. of fruits plant ⁻¹	Fruit yield/plant
T ₁	13	182	14	364	20	140	23	115
T ₁	15	255	15	420	23	207	25	150
T ₂	15	270	18	540	25	225	26	156
T ₃	14	235	15.7	441	22.7	191	25	140
CD (P = 0.05)	1.05	1.16	1.3	10.37	1.66	18.61	1.37	7.1

Field experiment

Number of fruits plant⁻¹ (Table 3)

There was a significant difference in number of fruits plant⁻¹ due to treatments in bhendi. Among the treatments, T₃ recorded the maximum number of 18 fruits, while T₁ recorded the minimum of 12 fruits plant⁻¹. There was a significant difference due to treatments in respect of number of tomato fruits plant⁻¹. Among the treatments T₃ recorded maximum number of fruit (22) compared to T₁ (15). The influence on number of chilli fruits plant⁻¹ due to treatments were significant. Maximum number of fruits were found in T₃ (47), while minimum was in T₁ (34). The number of fruits plant⁻¹ varied significantly due to treatments in cluster bean. The plants from seeds treated with T₃ recorded the maximum number of fruits (49), while treatment T₁ recorded the minimum fruits (36).

Table 3. Effect of seed hardening treatments on No. of fruits/plant and fruit yield (g plant⁻¹) of bhendi cv. Arka Anamica and Tomato cv. PKM 1, Chilli cv. K2 and Cluster bean cv. Pusa Navbhar under field experiment

Treatment (T)	Bhendi cv. Arka anamica		Tomato cv. PKM 1		Chilli cv. K2		Cluster bean cv. Pusa Navbhar	
	No. of fruits plant ⁻¹	Fruit yield/plant	No. of fruits plant ⁻¹	Fruit yield/plant	No. of fruits plant ⁻¹	Fruit yield/plant	No. of fruits plant ⁻¹	Fruit yield/plant
T ₁	12	196	15	358	34	156	36	132
T ₂	18	268	20	426	42	226	45	168
T ₃	18	284	22	472	47	245	49	182
T ₄	16	249.3	19	418.9	41.1	209	43	160.67
CD (P = 0.05)	0.62	2.16	1.51	0.15	4.95	12.6	2.6	2.20

Fruit yield (g plant⁻¹) (Table 3)

Bhendi fruit yield plant⁻¹ varies significantly due to hardening treatments. Fruit yield from the plants of T₃ recorded the maximum of 284g compared to T₁ (196g). The tomato yield per plant varies significantly among the treatments. Maximum fruit yield was recorded in treatment T₃ (472 g), while T₁ recorded the minimum (358 g). The yield of fruit plant⁻¹ was significantly influenced by different treatments in chilli. The fruit yield was higher in T₃ (245 g), while lower in T₁ (156 g). The cluster bean fruit yield varied significantly due to treatments. The seeds from treatment T₃ recorded the maximum yield of 182 g compared to T₁ (132 g).

V. DISCUSSION

Vegetables are considered as the most important cheap and readily available source of minerals and vitamins irrespective of their food value for the predominantly vegetarian population of India. Vegetable seeds are high value low volume seeds in which germination and establishment of crop growth are the major concern under rainfed condition. To alleviate this problem, presowing seed quality enhancement with nutrients is the need of hour.

In the farming system of tribal farmers of study area, they are not growing vegetable crops. However, inorder to verify the suitability and performance of vegetable crops with hardening treatments under rainfed conditions of tribal habitations, the commercially important drought tolerant vegetables such as bhendi cv. Arka Anamica, tomato cv. PMK 1, chilli cv. K2 and cluster bean cv. Pusa Navbhar were raised after seed hardening mainly to assess the efficacy of treatment in improving growth and crop productivity (Plate 8).The hardened seeds were evaluated initially under laboratory and pot culture studies and then the efficacy of the treatments were observed under field conditions of tribal farmers during rainfed situations and the results obtained are discussed here under.

Plate 8: Influence of KH₂PO₄ on crop stand and productivity



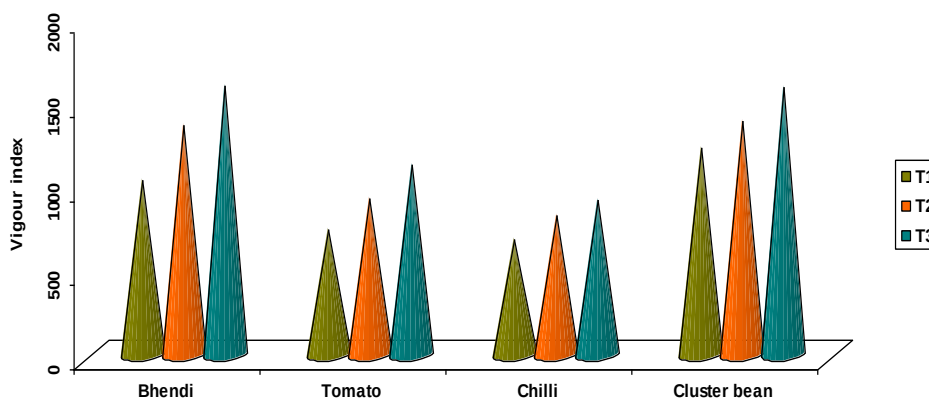
Bhendi



Cluster Bean

In bhendi the seeds hardened with KH_2PO_4 (0.5%) performed better at all stages of evaluation viz., laboratory,

Fig. 7 Effect of seed hardening on vigour index of vegetables



pot culture study and field experiment. Under laboratory condition T_3 seed hardened with KH_2PO_4 @ 0.5% for 16h registered increased level of germination (14.6%) and vigour index (54.4 %) compare to control seeds. Similar results were obtained by Gray *et al.* (1977) in parsnips, Kohli *et al.* (1992) in garden pea, Renugadevi *et.al* (1994) in bitter gourd, Srimathi *et al.* (2002) in Tomato, Sanchez *et al.* (2001) in tomato, pepper and cucumber. In case of pot culture and field experiments, the seeds hardened with KH_2PO_4 (0.5%) performed better in increasing the number of fruits plant⁻¹, fruit weight, fruit yield plant⁻¹ was significantly higher in the case of KH_2PO_4 (0.5 %) hardened seeds. The fruit yield increase was 48.4 per cent higher than control. Though the KCl hardened seeds were slightly inferior to the above treatment, it could also able to record 40.1 per cent higher fruit yield than control. The results are in accordance with the Mehrotra *et al.* (1968). In the present investigation, through laboratory evaluation tomato seeds hardened with KH_2PO_4 (0.5 %) recorded higher germination and vigour, which is 12.2 and 51.7 per cent respectively higher than the control untreated seeds. Similar results were obtained by (Doijode and Raturi, 1987; Kohli *et al.*, 1992; Renugadevi, *et.al* 1994 and Srimathi *et al.*, 2000). Increase in number of fruits plant⁻¹, fruit weight, yield plant⁻¹ due to hardening of seeds with KH_2PO_4 (0.25%). The fruit yield increase was 37.5 per cent higher than the control. The increase by KH_2PO_4 might be attributed to its powerful synergistic interaction with avoidable auxin (Yopp *et al.*, 1981; Chio *et al.*, 1990). Similar results were obtained by Kuppusamy *et al.*, 1992; Nargis *et al.*, 1999; Srimathi *et al.*, 2002.

In the present study, the chilli seeds hardened with KH_2PO_4 (0.5 %) performed better in all types of evaluation viz., laboratory, pot culture and field experiments (Fig.7). Under laboratory evaluation KH_2PO_4 (0.5 %) hardened seeds recorded higher germination and vigour, which was 8.1 and 34.4 per cent respectively higher over control seeds. Such a positive effect of germination and vigour was also obtained by Kohli *et al.* (1992). Number of fruits plant⁻¹, fruit weight and fruit yield plant⁻¹ was also at maximum in seeds hardened with KH_2PO_4 (0.5 %). The fruit yield increase was 60.7 per cent higher than the control (untreated seed). Similar results were obtained by Srimathi *et al.* (2002) and Ananthakalaiselvi and Dharmalingam, (2002). The increase in crop growth and yield attributing parameters observed in the present investigation might be due to early influence of hardening treatments.

In the present investigation, under laboratory evaluation cluster bean seeds hardening with KH_2PO_4 (0.5 %) recorded higher germination and vigour which was 10.5 and 29 per cent respectively higher over control.

Similar results were obtained by Vijaykumar *et al.* (1998). In case of both pot culture and field experiments, seed hardened with KH_2PO_4 (0.5 %) performed better. There was an increase in field emergence and other growth parameter were observed for the hardening treatment compared to control. Similar results were obtained by Nargis *et al.* (1999), Anandakalaiselvi and Dharmalingam (2002). Like wise in yield parameters also the seeds hardened with KH_2PO_4 (0.5 %) performed better, the yield was 37.5 per cent higher than the control (Fig.8). This is in confirmity with findings of Nargis *et al.* (1999) and Srimathi *et al.* (2000). The probable reason for increasing yield was due to increased early seedling vigour, crop growth and yield attributing parameters visualised in the plants of hardened seeds.

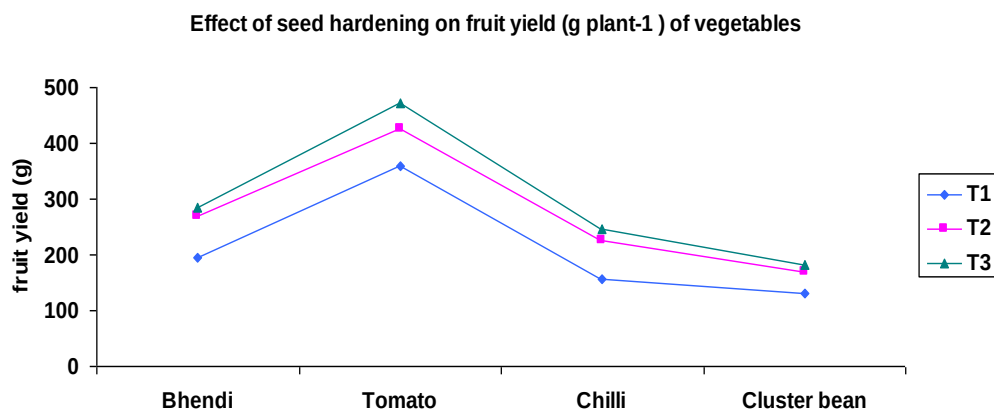


Fig. 8 T₁ – Control ; T₂ – Seed hardened with KCl @1% ; T₃ – Seed hardened with KH_2PO_4 @ 0.5%

VI. SCOPE ACCRUED OUT OF THE STUDY

Generally tribal population in our country remains a knowledge deprived society. The agricultural practices have gained leaps and bounds through knowledge development, dissemination and deployment out of sustained scientific research and streamlined extension activities. The present study took up the noble task of delivering through demonstration, the most suitable agro techniques to improve the productivity of tribal agriculture. The onfarm experiments and their first hand knowledge dissemination has enlightened the poor tribal farmers on the merits of simple techniques which would benefit them in the long run to realise a sustainable growth in the productivity of their deprived high lands. The acknowledgement of the merits of the experiments by the tribal farmers in the study area is currently reflected by many simulated demands for improved varieties and hands on training on technologies.

VI. REFERENCES

- Abdul-Baki, A.A. and J.P Anderson. 1973. Vigour deterioration of soybean seeds by multiple criteria. *Crop Sci.*, 13: 630-633.
- Ananthakalaiselvi, A. and C. Dharmalingam. 2002. Soaking / pelleting with botanicals as a cheap technology to improve germination and vigour of papaya seeds (*Carica papaya* L.) cv. CO.2 South Indian Hort. 46 (3&4) 132-134.
- Anonymous. 2002. Annual report of the All India Co-ordinated Research Project for Dryland Agriculture, Kovilpatti Centre (2002-03) pp. 34.
- Chio, C.D., S.C. Kim and S.K. Lee. 1990. Interaction between brassinolide and auxins on bioassays. *Korean J. Crop. Sci.*, 35(1): 58-64.
- Doijode, S.D. and G. Raturi. 1987. Effect of hydration-dehydration on germination and vigour of certain vegetable seeds. *Seed Res.*, 15(2): 156-159.
- Gray, D., R.A. Joyce and Steckel. 1977. Effect of pre-sowing treatments of seeds on the germination and establishment of parsnips. *Journal of Horticultural Science*: 525-534.
- ISTA, 1999. International Rules for Seed Testing. *Seed Sci. and Technol.*, Supplement Rules, 27: 25-30.
- Kohli, V.K., I.K. Thakur and Y.R. Shukla. 1992. Studies on improving field emergence in the autumn crop of garden pea (*Pisum sativum* L.) *Ann. Agric. Res.*, 13(4): 394-395.
- Kuppusamy, G., A.R. Lakshmanan and A. Jeyabal. 1992. Effect of seed pelleting with biodegraded slurry and macro nutrients on rice fallow greengram cv. CO 2. *Madras agric. J.*, 79(4): 183-187.
- Mehrotra, O.N. J.P. Srivastava and S. Nath. 1968. Germination, growth and yield of wheat as influenced by pre-sowing seed treatment in phosphate solution. *Indian J. Agron.*, 13(2) : 53-56.
- Nargis, S., M. Gunasekaran., S. Lakshmi, and C.P Thiagarajan. 1999. Pelleting and soil moisture at different levels on quality of differentially aged seeds in tomato (*Lycopersicon esculentum*. Mill). *South Indian Horticulture*, 47(1/6): 267-269.
- Panse, U.G. and P.V.Sukhatme. 1985. In: Statistical methods for Agricultural workers. ICAR, Publication New Delhi, p.327-340.
- RenugaDevi, J. and Jacqueline, A. Selvaraj. 1994. Effect a pre-sowing treatment on germination and vigour in bitter melon (*Mimordica charantia* L.) cv. Col. *Seed Research Vol* 22(1): 64-65.
- Sanchez, J.A., B.C. Munoz and J. Fresneda. 2001. Combined effects of hardening hydration-dehydration and heat shock treatments on the germination of tomato, pepper and cucumber. *Seed Sci. & Technol.*, 29(3): 691-697.
- Srimathi, P. K. Malarkodi, R. Geetha and V. Krishnasamy. 2002. Influence of presowing pelleting treatment on seed yield and storability of soybean. *Orissa J. Hort.*, 28(2): 33-35
- Srimathi, P., K. Malarkodi, R. Geetha and V. Krishnasamy. 2000. Influence of pre sowing pelleting treatment on seed yield and storability of tomato cv. PKM-1. *Orissa J. Hort.*, 28(2): 33-35.
- Yopp, J.H., N.B. Mandava and J.M. Sasse. 1981. Brassinolide a growth processing steroidal lactone. *Physiol. Plants.*, 53: 445.